Chapter 3: The Gold Cup

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General condition and problems

The image presented by the Ringlemere cup is striking partly because of the obvious quality of the original workmanship, but also because of the severe crumpling it has suffered (**Colour Pls 1 & 2**). The greater part of the damage appears to be due to impacts of similar nature – heavy blows with a hard, pointed object or objects. The most swinging blow was received to the middle of the side opposite the handle at or just below the carination, leaving this side with a deep cleft. Diametrically opposite is a lesser dent just below the handle, presumably arising from resistance to this impact. Because of the rigidity of the corrugated conical lower body the main cleft has caved in as a roughly triangular shape with crisp surrounding arrises. To the right of it the original morphology is little affected, but to the left of the cleft there is another lesser dent, again with a linear central crease running vertically up the body. This is the only significant damage to encroach on the uncorrugated, basal part of the body (**Pl. 12**).

It is probable that the main blow and the opposing resistance, which nearly pinched together part of the middle of the body, also accounts for the flattening of the upper body roughly into a narrow pointed ellipse (**Pl. 3**). At the two ends of this ellipse the rim and neck have been crushed on a near-vertical axis into acute angles. The remainder of the circumference features other more or less severe buckles interspersed with seemingly more intact stretches. The stresses involved have acted unevenly causing the sheet metal to fold at a limited number of points on the circumference. The stretch of wall inside the handle has been partially flattened, the handle itself having been pressed up against it and almost folded double towards the top (**Pl. 4**). A tear runs half way across this fold, and there is a further substantial tear across the lower end where it joins the carination because the handle has been pulled upward in the process of being crushed (**Colour Pl. 2**).

Another substantial blow has caused damage of different character. It has badly gashed the side of the vessel to the right of the handle base (**Pl. 5**). The metal immediately around the gash shows marked but local crumpling on both faces and part of a rectangular impression has been left on one edge.

As close inspection proceeded, it became apparent that there was a sudden turn in profile at the top of the 11th rib (numbered from the bottom rib upwards) for the greater part of the circumference. The upper body (neck) has partially collapsed, or concertinered, into the lower body, leading to a marked double bend at the carination. This leaves the body immediately above for the most part inaccessible because it is tucked inside the double bend.

Explaining this collapse is not straightforward. One possibility considered was that it derives from an earlier phase of damage, due to strong or sustained pressure on a vertical axis through the cup. Further reflection, however, makes this unlikely. It would have had to be uneven compression which allowed one side to survive unaltered, in which case one would expect evidence of a gradational change between the intact profile on one side and the markedly altered profile opposite. Instead, the change is sudden at two creases – one negative the other positive – associated with the main crushing. This strongly suggests that the partial concertinering was integrally linked to the other major damage and caused by multi-directional stresses acting on a complex three-dimensional geometry.

It would be extremely important to determine how much of the damage was modern and how much ancient, for example, deriving from pre-depositional rituals. Although there are at least four major aspects of damage – two large dents, the gash, the vertical concertinering – these do not necessarily imply separate events. All could actually be reconciled with the

Plate 3 Top view showing crushing of the mouth

Plate 4 Profile view showing crushed handle

Plate 5 Detail of gash in side of body

incidence of a single massive blow from agricuatural machinery with consequent crumpling effects due to soil resistance and the geometry of the hollow object. Equally, there is no certainty that the damage was all simultaneous.

What may be significant, however, is that there are no occurrences of multiple contiguous or overlapping dents that might be expected had the object been subjected to a sequence of blows from an ancient implement. If, therefore, we are to contemplate the possibility of ancient damage, it has to be seen as 'single-strike' in any given orientation. On balance the character of the damage observed seems much more likely to be the result of one accidental, but substantial encounter with a massive object.

Surface patination

by Susan La Niece

The gold has a distinctive, fine-grained, red patina, preserved in the recesses, particularly in the folds of the damaged area, and inside the rim. On some areas just inside the rim there are unexplained linear marks in the patina. Endoscopic examination shows the patina layer is thinner inside the cup. It is not present on the most accessible areas of the outer surface, where it had been rubbed with a cloth previously used by the finder for polishing coins. Traces of corundum (alpha-alumina, Al_2O_3) were identified by X-ray diffraction analysis in the pointillé decoration and crevices where the handle joins the body of the cup. This is an abrasive, here probably representing modern residues of chrome polish on the cloth.

The red patina was identified by X-ray diffraction analysis as silver gold sulphide (AgAuS) (JCPDS 19-1146). This patina was first published from research into silver-rich gold antiquities from Egypt (Frantz and Schorsch 1990). This is the first recorded instance of the patina from Britain, perhaps because it is rare for gold objects to be examined straight from excavation, before thorough cleaning.

Reconstructing the original form

No restoration of the cup has been attempted because of concern that opening the severe buckles might alter the metal structure. This made even more important the need to create a virtual restoration to allow good visualisation of the object in antiquity. This has proved to be doubly important given that the profile reconstructed was not that initially assumed from casual inspection.

Undistorted segments of the cup show good circularity in plan and we can assume that it was close to circular from top to bottom. Virtual restoration then depends on three types of observation:

partial profiles taken from intact segments;
total surface length of the profile along any radial slice;
circumferences at a range of planes through the full depth of the vessel.

The sheet metal being relatively thick, it is thought that any stretching due to distortion is likely to be insignificant. Taken together these observations act as a constraint on one another and, if sufficient data can be obtained, there is little margin for error in the overall reconstruction. Judging a segment to be intact depends on observing an even radial curvature, a lack of any obvious dents and creases, and internal 'coherence' between the features (mainly ribs) contained. There are three segments of near-intact profile which are large enough to offer valuable information on shape.

Intact segment A: The first is obvious – one side of the lower body running all the way from the base up to rib II. The profile (**Fig. 22; Pl. 6**) must be very close to the original even though there may be slight distortion of some radii due to the severe damage to either side. As a double-check on radii, circumferences were measured around ribs I and II, a process made difficult by the deep cleft in the front of the body.

Intact segment B: A smaller segment situated within one side of the pronounced cleft is somewhat surprisingly intact. This was not at first appreciated, but is of enormous significance because in addition to the smoothly cusping profile of ribs 6–10 of the lower body, it shows the profile to turn at rib 11 and continue at a new angle for ribs 12 and 13 before any significant distortion intervenes (**Fig. 22; Pls 7 & 8**). What this segment shows beyond any doubt is that the middle of the cup was not the weak or moderate carination familiar on its parallels. Instead the upper body turns suddenly inward at rib 11 producing a shoulder occupied by ribs 12 and 13. The shoulder is sloped, forming an angle of about 110° with the body below and thus nearer to the horizontal than the vertical. The presence of this strong

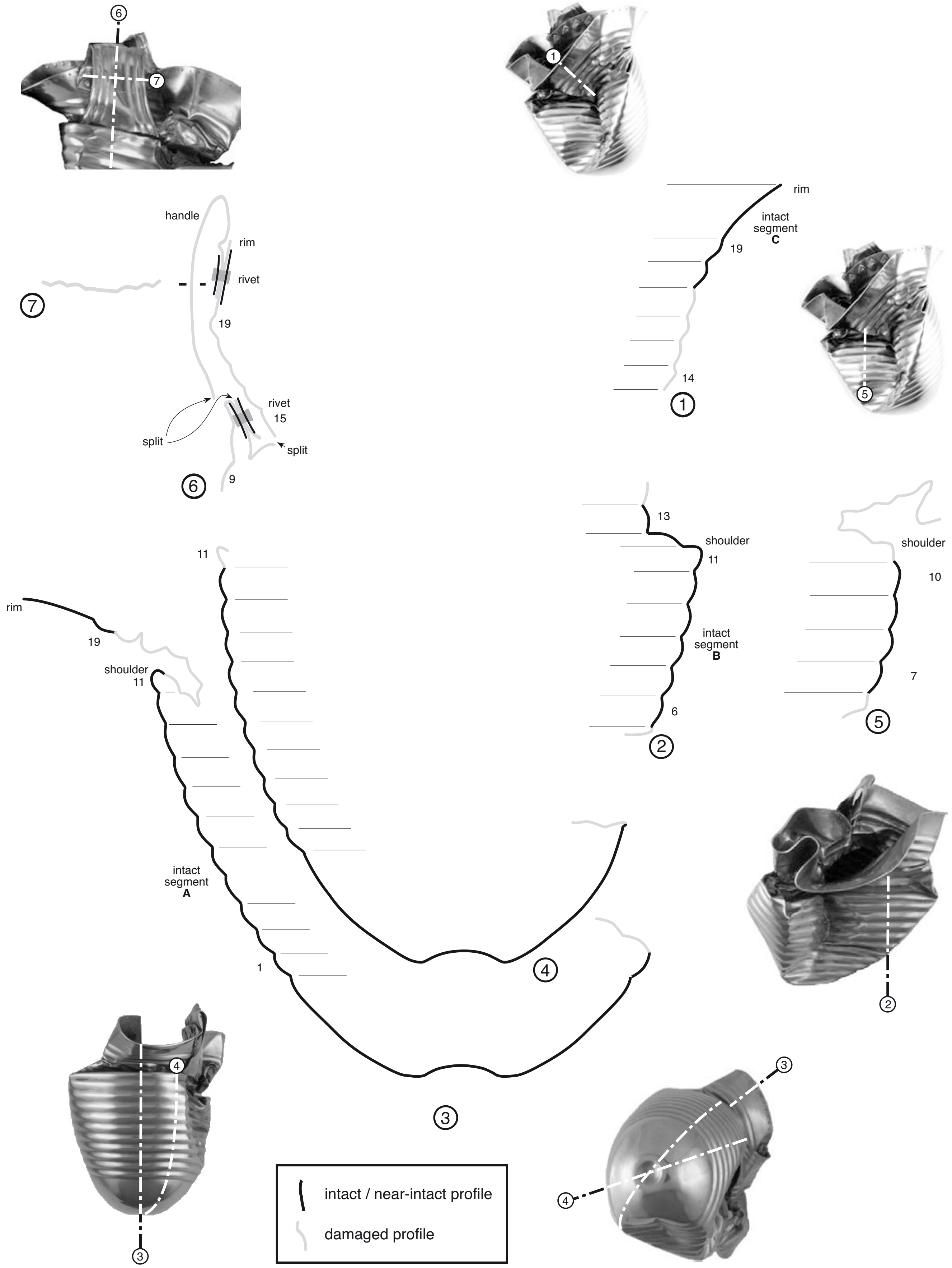

Figure 22 Drawn profiles of the crushed vessel at selected points (scale 100%)

Plate 6 Profile of intact segment A, the lower body

Plate 7 Face view of intact segment B (outlined)

shoulder undoubtedly explains the concertinered damage described above.

Intact segment C: Fortunately the third segment encompasses part of the rim and extends down through the smooth band and then ribs 19 and 18 before some flattening or buckling of ribs 17 onwards (**Fig. 22; Pl. 9**). This segment is not pristine, but undulations are minor and the broad form unlikely to be much altered. It gives a good basis for the angle at which the rim stood and the profile of the upper neck. Although difficult due to the severe contortions, it was possible to obtain circumference measurements at the rim itself and on rib 19 and thus a reliable reconstruction of the mouth of the cup.

The mouth portion is, however, left floating free relative to the lower body and shoulder. Ribs 14–16 are disfigured all round and, moreover, these plus ribs 12–13 are inaccessible for much of their circumferences because of the concertinering. The shape of the neck is therefore the least well documented empirically and has to be interpolated between the other profile stretches. In practice, the established angles of the latter in conjunction with the measured depth of ribs 14–16 leave little uncertainty in the linkage.

For the virtual restoration (**Colour Pl. 3**), the body was generated through a 'lathed profile' and the handle was based on a 'swept profile', both available in standard computer 3D-graphics packages. The work was undertaken by Stephen Crummy.

Description of the reconstructed form

The Ringlemere cup would have stood around 123mm tall, the greater part, 78mm, being the lower body to the shoulder (**Fig. 23**). The diameter at the shoulder was 96mm, that at the neck a minimum of about 76mm and at the rim 109mm. It currently weighs 183.7g, which should be close to the original weight since very little if any metal has been removed at the gash. Further dimensions, both measured and calculated, are given in the catalogue.

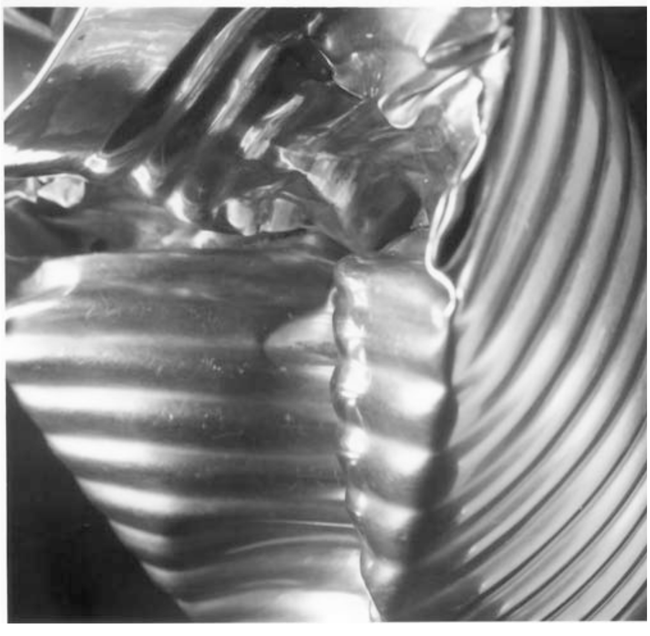

Plate 8 Profile of intact segment B

Plate 9 Face view of intact segment C (outlined) with the rim horizontal

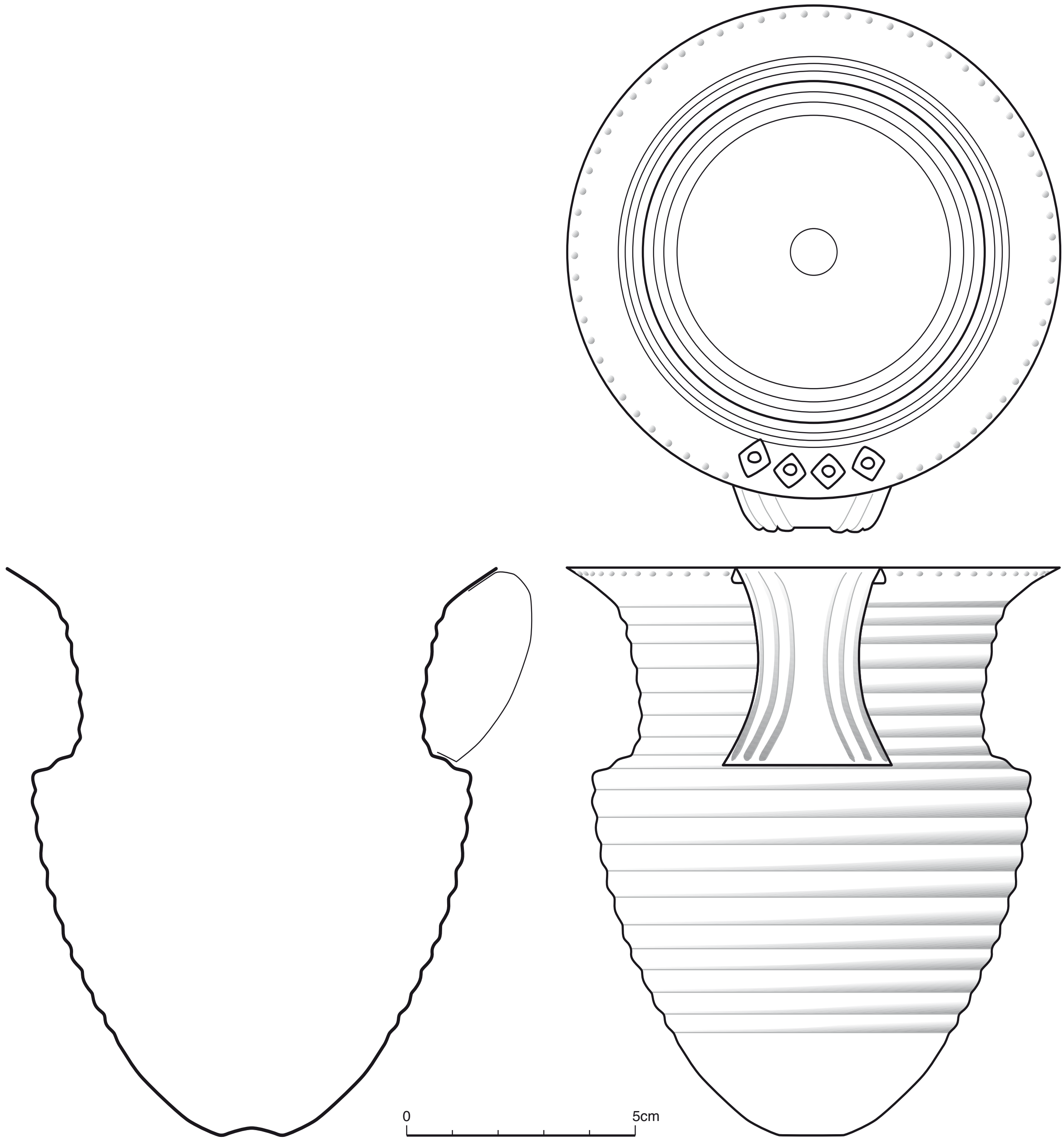

Figure 23
Reconstruction drawing of the Ringlemere cup (scale 67%)

Starting at the base, there is an incredibly neat omphalos just 12mm in diameter and 2.0mm deep. The wall initially rises in a smooth gently convex profile and this sweeping curve is maintained for the ribbed part. The wall is essentially vertical by the time it reaches the shoulder. The ribs both here and higher each present an even curve in profile and meet at sharp creases between. The only rib with a different profile is that on the shoulder, rib 11; a relatively sharp (but not angular) turn divides this broader rib into two, a vertical lower part and a more horizontal upper part.

Above rib 11 the upper body presents a strongly concave and slightly asymmetric profile overall. The minimum diameter would have been below the centre with a strong curve to the shoulder and a more gradual curve sweeping out to the well flared rim. Most of this is ribbed, but the uppermost band of 15mm returns to a smooth metal profile and presents the rim at around 35° to the horizontal. The rim itself is in the same order of thickness as the rest of the walls and is basically flat-topped. Immediately beneath the rim is a row of 62 dots punched from the outside of the vessel and interrupted only at the handle.

While the body of the vessel has all been raised out of a single piece of gold, the handle is a separate piece of sheet metal attached top and bottom by four rivets passing through tab extensions. The handle has a fairly symmetrical hour-glass shape in face view, is about 0.3mm thick at the edges and is decorated and strengthened by ribbing outlining either side (**Pl. 6; Colour Pl. 2**). The ribbing is again cuspate with two ribs between three grooves in each set. The central zone was flat, but is now a little buckled. The handle expands to its broadest at the tabs which are turned inwards to rest flush on the corresponding parts of the body. The upper tab is attached to the smooth wall immediately below the rim and, as reconstructed, would have only needed to be gently angled from the top of the handle. The lower one must instead have turned inwards sharply, approaching a right-angle, and is affixed to rib no 12, that on the shoulder closest to horizontal.

For the top fixing, the nature of the riveting is easily observed inside the vessel (**Pl. 10**), but for the outside the crushing of the handle means that only the outermost rivets are really visible. The lower fixing is much more difficult to view. The collapse of the shoulder on this side of the cup has taken the tab down into the tight double fold. Very little of the outside

Plate 10 Detail of the inner upper rivet fixings

rivets can be seen by looking into the external fold beside the handle, while the internal ones are tucked up a similar fold not visible from the mouth of the cup. A boroscope, operated by Tony Simpson (the British Museum, Dept. Conservation, Documentation and Science), enabled something to be seen of the latter and about half of one outer rivet can be seen from the inside through a tear in the vessel wall (**Pl. 11**). Radiography confirms that size of rivets and their washers, plus orientation of the latter, are consistent throughout the lower tab.

All rivet ends show the same arrangement with circular, slightly domed and probably only slightly expanded heads barely protruding beyond their diamond-shaped 'washers'. The shallow dome meets the washer almost seamlessly to the naked eye and there are no visible cracks from the clenching process. Slight hammer marks are evident under magnification, but the heads have probably been well polished after closure. Dimensions are typically around 3mm for the diameter of the heads, 8.5–10mm for the length of (accessible) washers and 7–8mm for their width. In three positions the washers have their long axis horizontal relative to the body; this was advantageous in terms of the ease of fitting the washers on and in a rib (lower fixing) or under the turn (upper fixing). However, inside the vessel at the top they are instead set vertically, presumably for design effect where they would have been most visible.

Metal composition

by Susan La Niece

The gold composition was identified by X-ray fluorescence analysis. It was possible to analyse the main components, the cup and the handle, on both the surface as found, and on small areas of fresh metal, where there was already some damage. The results illustrate the extent of surface enrichment caused by burial corrosion, or perhaps by the manufacturing process. A similar degree of enrichment might also be surmised for the

Plate 11 Detail of inside of cup showing a lower outer rivet head through a tear

rivets and the washers, on which only surface analysis was attempted.

The gold composition, with only trace levels of copper but a significant quantity of silver in the metal, is consistent with the use of alluvial gold with no refining or deliberate alloying. This is typical of Early Bronze Age British goldwork (Hartmann 1982).

		wt %		
		Au	Ag	Cu
Cup	– surface	82	18	0.2
	–- clean metal	76.9	22.9	0.2
Handle	–- surface	74	26	0.4
	–- clean metal	71.6	27.5	0.9
Rivet	–- surface	77	23	0.8
Washer	–- surface	78	21	0.5

The analyses have a precision (a measure of reproducibility) of c. ± 2% relative for gold, *c.* ± 5% for silver and *c.* ± 20-50% for copper, the precision deteriorating as the detection limit of 0.1% is approached. The accuracy of the analyses on clean metal should be of a similar order.

Traces of manufacture, wear and damage

Rivet washers

There is an important difference in detailed shape between the upper washers under the handle and those inside the mouth. The former are rather crisp around all their edges including the corners. This is also the state of the one visible outer washer in the lower row. In contrast, all of the exposed corners and edges on the upper internal washers are rounded off to some degree (compare **Pl. 5** with **Pl. 10**). Only the outermost tip of washer 4 under the handle is similar in this respect. These differences are all consistent with the fact that the inner rivets and washers would have been much more exposed to rubbing during finishing and/or use. It seems rather unlikely that differential rubbing would have resulted just from the finishing; surfaces under the handle could easily have been reached by burnishing tools if there had been the desire to bring the whole surface to a consistent level of polish. So while it is possible that some 'wear' occurred during finishing, it is suggested that the strong differential in wear was due to repeated attrition over a period of use. Logically, it could have arisen through regular cleaning of the inside of the vessel which was not so necessary under the handle.

Rim

Evidence from around the rim has similar implications. The one stretch relatively inaccessible to casual contact, that alongside the handle, has a flat top with crisp angles, although the inner, more exposed one is fractionally more rounded under magnification. By contrast, for the rest of its circuit the 'angles' are significantly rounded both internally and externally, leaving just a narrow flat band in between. It may be inferred that the rim started with a crisp square profile when the body was finished and before the handle was attached. Subsequent rubbing, probably mainly during its use-life, progressively reduced this to a sub-square profile.

Base

The omphalos is still very neat in outline and profile (**Pl. 12**). Its surround shows two possible patches of wear in diametrically opposing segments, but these are so slight as to be of uncertain significance. Other subtle dents and creases around the unribbed zone are side effects of the major damage or, in some cases perhaps, original hammer marks not fully planished out.

Striations

There are many very fine striations running circumferentially all over the body which result from finishing, re-polishing in antiquity and the finder's cleaning. Striations of similar grade run instead vertically on the handle, but this is to be expected since the best surface finish would be obtained by polishing in line with its linear mouldings.

A series of coarse parallel striations aligned diagonally on the handle are clearly secondary (**Pl. 5**). They are limited to the flattened central stretch in between the double bend at top and a slight bend towards the bottom, hence formed at the time of the crushing, or subsequently.

There is a third, intermediate grade of striations, in the order of 0.05mm wide, in two locations on the plain band below the rim. In both cases a band of roughly horizontal striations continues round a tight bend in the mouth. Their formation must therefore precede the major damage and, while a phase of slight abrasion due to movement in the ground is possible, the relative fine-ness of these scratches and their alignment favours that they are due to rotational rubbing/scouring of the mouth during use.

There is a multitude of other small marks over the surface, some clearly associated with the major damage episode and others, running parallel to major lines of buckling, almost certainly due to cleaning.

Dot decoration

The punched dots frequently have a slight lip to the left of the impression, suggesting that the tool used was being struck from the right at a slight angle to the perpendicular.

Plate 12 Detail of base showing the omphalos

Technology of production

by Susan La Niece

The body of the cup was made in one piece by hammering. A goldsmith today would take a flat disc of gold and hammer it while holding it firmly against a stake to force the metal progressively into the form of a hollowed vessel of the required proportions (Armbruster 2000, 159 fig. 88). Annealing, that is heating to relieve stresses in the metal, is required at regular intervals in the process. Working from the centre, the metal is beaten while continually rotating the gold against a series of stakes until the required diameter of the cup is obtained. At intervals the craftsman will ensure that the rim is thickened by tapping at right angles to the edge. Once the shaping is completed, the surface can be planished by gently tapping against a support, to smooth out any hammer indentations. The corrugations can be shaped by working the cup from the outside against a former held inside. The former need only be a block of wood into which a number of grooves are cut. The cup is rotated a few degrees and repositioned on the former, to continue the grooves around the circumference. The surface can then be polished with fine abrasives.

The handle was hammered out as a flat strip then cut to the required shape. The longitudinal grooves were worked from one face, leaving rounded ribs between. Once completed, the strip was bent to form the handle, the ends turned to form attachment tabs, perforated and then secured with domed rivets. These were hammered tight from the inside of the cup while the cup was supported.

No advanced tools or materials would have been required for making a vessel of this type; the technology can have changed very little since the Ringlemere cup was made. However, the quality of the workmanship does indicate that the goldsmith had considerable experience in making fine goldwork.